Error Signal

Process Variable

Sensor

12

13

14

Setpoint

15

Error Signal

$Output_c = K_a(Error) - K_{Bias}$

Asymptotic Approach Controller

Disturbances

11

Process / System

Final Control Element (Variable Output Device)
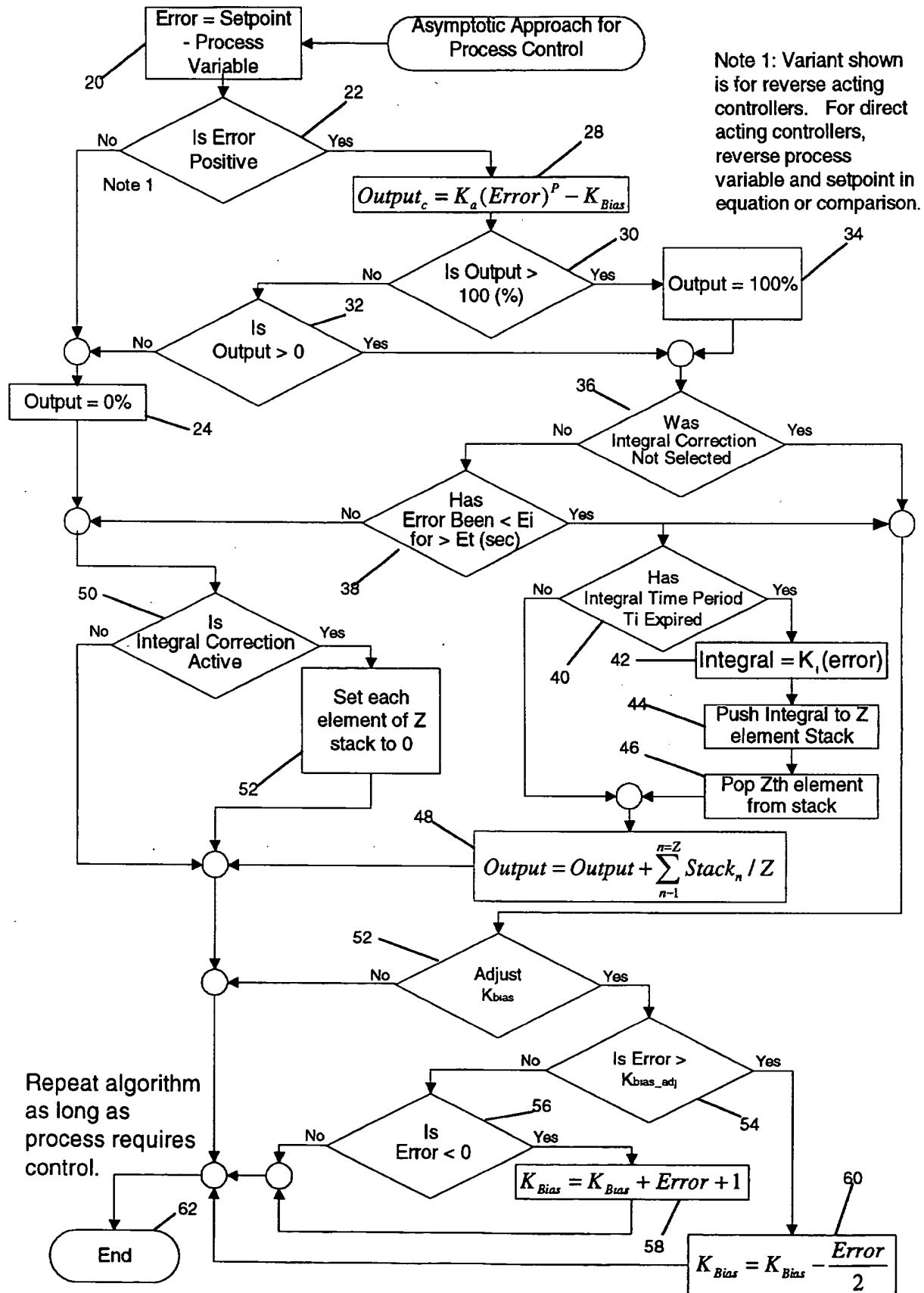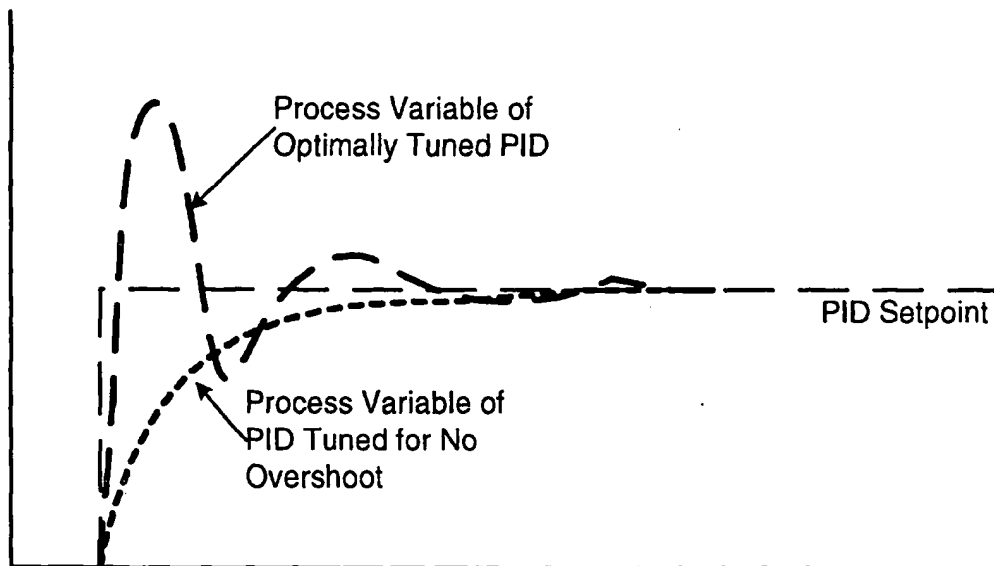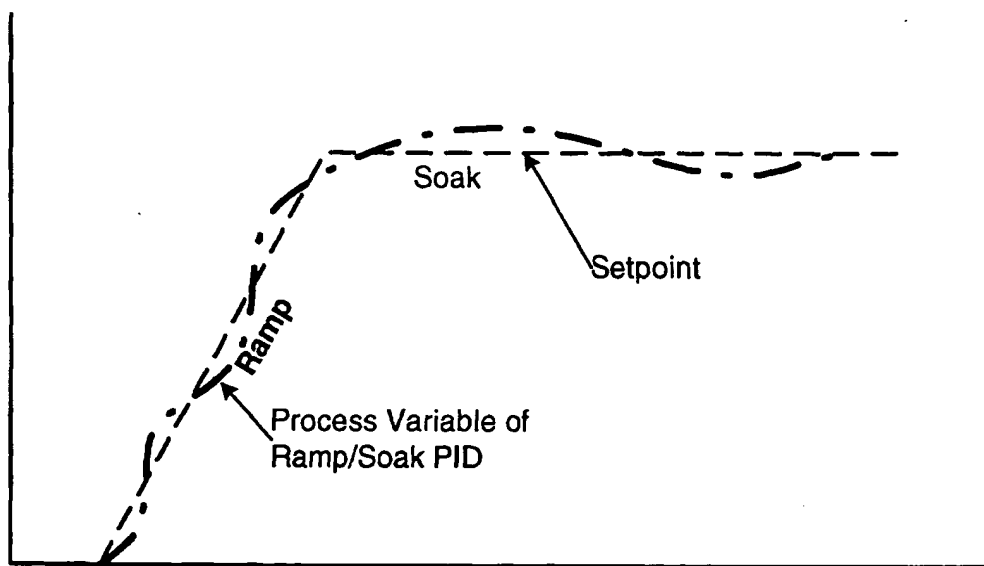
17

16

Control Variable

FIGURE 1: FEEDBACK CONTROL SYSTEM

Asymptotic Approach for Process Control

Error = Setpoint - Process Variable

20

Note 1: Variant shown is for reverse acting controllers. For direct acting controllers, reverse process variable and setpoint in equation or comparison.

22

Is Error Positive

No

Note 1

Yes

28

$$Output_c = K_a(Error)^P - K_{Bias}$$

30

Is Output > 100 (%)

No

Yes

34

Output = 100%

32

No

Yes

Output = 0%

24

36

Was Integral Correction Not Selected

No

Yes

Has Error Been < Ei for > Et (sec)

No

Yes

38

50

Is Integral Correction Active

No

Yes

Has Integral Time Period Ti Expired

No

Yes

40

42

$Integral = K_i(error)$

Set each element of Z stack to 0

52

44

Push Integral to Z element Stack

46

Pop Zth element from stack

48

$$Output = Output + \sum_{n-1}^{n=Z} Stack_n / Z$$

52

Adjust K$_{bias}$

No

Yes

Repeat algorithm as long as process requires control.

Is Error > K$_{bias\_adj}$

No

Yes

56

Is Error < 0

No

Yes

54

$$K_{Bias} = K_{Bias} + Error + 1$$

58

60

$$K_{Bias} = K_{Bias} - \frac{Error}{2}$$

End

62

Figure 2: ASYMPTOTIC APPROACH ALGORITHM FLOWCHART

Process Variable of Optimally Tuned PID

PID Setpoint

Process Variable of PID Tuned for No Overshoot

Figure 3: OPTIMALLY TUNED PID CONTROLLER CURVE
Prior Art Reference
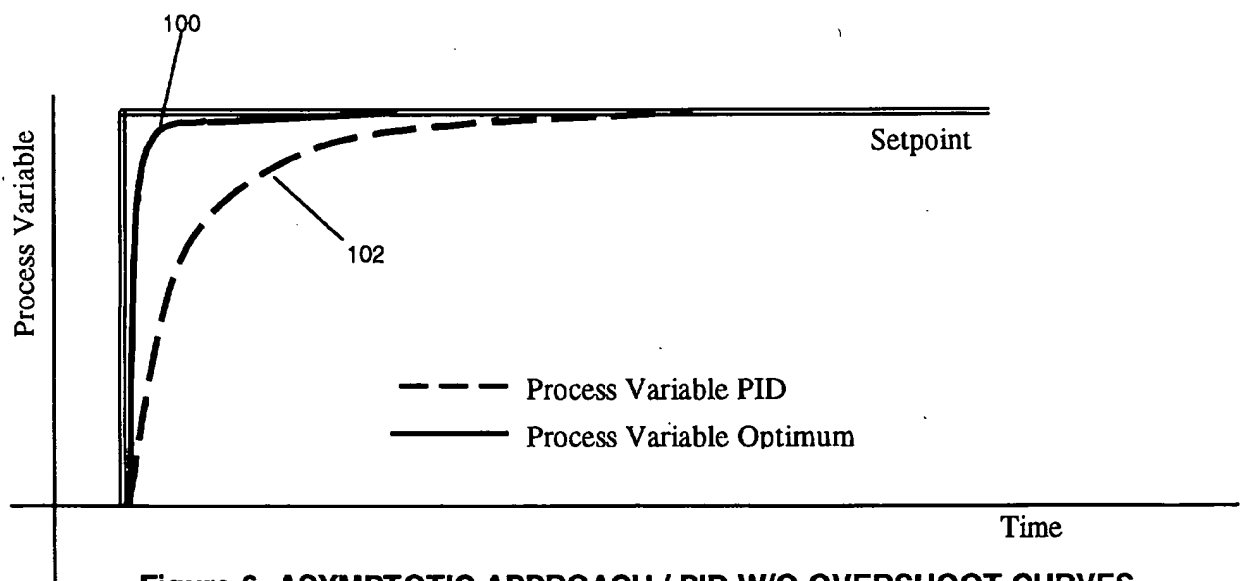

Soak

Setpoint

Ramp

Process Variable of Ramp/Soak PID

Figure 4: RAMP/SOAK CONTROLLER CURVE
Prior Art Reference

Figure 5: PID GAP CONTROLLER CURVE
Prior Art Reference

Figure 6: ASYMPTOTIC APPROACH / PID W/O OVERSHOOT CURVES